BOARD OF LAND AND NATURAL RESOURCES

State of Hawaii

PROPOSED GEOTHERMAL RESOURCES SUBZONE

INTEGRATED RESOURCES, INC.

535 WARD AVE., STE. 211, HONOLULU, HI 96814

June 20, 1988

BOARD OF LAND AND NATURAL RESOURCES
Chairperson: Mr. William Paty

Over the years, inquiries and surface tests were conducted by geothermal companies interested in exploratory drill tests on the subject property. Geothermal Resource Subzone Designation was discussed, but never pursued in the past. There exists a subject of doubt and clearity as to the status of the property concerning (1) property zoning previous to the 1981 Geothermal Resource Subzone Designation to one-half of the parcel and (2) appropriate application to either Modify the Boundary (Sec. 13-184-10) or to initiate subzone designation (Sec. 13-184-5).

ZONED FROM CONSERVATION TO AGRICULTURE

The 85 acre parcel was acquired in 1972 and over the past 15 years of ownership and involvement, the proposed parcel was designated under several land use categories:

1. Split-Zoning: (2 different zoning)

   45 acres ... Agriculture Zoning
   40 acres ... Conservation Zoning

2. Geothermal Resource Designation (1981)

   45 acres ... Changed from Agriculture to Geothermal Resource Subzone
   40 acres ... Remained in Conservation Zoning

3. Zoning Change from Conservation to Agriculture

   45 acres ... No Change-Geothermal Subzone
   40 acres ... Changed from Conservation to Agriculture Zoning (See Attachment A, Newspaper Notice)

MODIFICATION OF BOUNDARY (Section 13-184-10)

In addressing the effective date of State zoning of the 40 acre parcel from Conservation to Agriculture Zoning, relative to the 1981 Geothermal Resource Subzone Designations in the area, Modification of the boundary line would be justified in this case.

Justification to be based on

(1) Common ownership of the entire parcel that was designated with two different zonings.
(2) 40 acre parcel was zoned Agriculture by the State, instead of Conservation, previous to any subzone designation by the State (1981).

Geothermal energy is the major, viable alternative energy resource in Hawaii, capable of producing electricity in quantities that could alleviate the State's dependency on imported petroleum. The 40 acre proposed parcel for designation is the only large property in a known and proven geothermal resource area that could be used effectively for two purposes, (1) for generation of electricity and (2) as a "user" facility for industries using residual or low temperature steam.

ELECTRIC GENERATION

A defined high-temperature geothermal reservoir was mapped by University of Hawaii geophysicist Furumoto and confirmed by the success of the University HGP-A demonstration Plant in Puna. The proposed parcel is located within the same defined geothermal reservoir as determined by the Furumoto Survey.

Numerous unsuccessful exploratory drill-bores were made at potential sites using different technologies and techniques, costing millions of dollars. This reveals the inexact nature of geothermal resource development that could lead to the abandonment of geothermal energy as an alternative energy resource.

ELECTRIC GENERATION (Continued)

Until better and economical technology can be developed to locate geothermal resources, the proven geothermal resource reservoir area must be designated to allow drilling to occur and permit private companies to develop the resources at the lowest cost.

A number of successful high-temperature geothermal producing wells must be developed to generate sufficient amounts of electricity to sustain the credibility of geothermal as an alternative resource in the State of Hawaii as well as supply planned transmission lines across the Island. This goal could be accomplished by the full utilization of the proven geothermal reservoir located in Puna, at the HGP-A Well-Site vicinity.

NON-ELECTRIC PRODUCING USER FACILITY

Of great priority, would be the Applicant's intent to accomodate the users of residual or low-temperature geothermal steam. Numerous inquiries generated from projects using the research facility at the HGP-A demonstration facility and from institutions and industries interested in using geothermal fluids and steam indicates an immediate need for on-site users of residual steam or low-temperature steam.

The proposed property is a level parcel with existing infrastructure that include electricity, water and paved roads. Viable industries and institutions interested in this particular location include (1) University of Hawaii, (2) Pacific Geo-Spa Group, (3) Hawaii Aqua Farm, (4) Silk Dyeing Hawaii, (5) Industrial Ice and Cold Storage and a papaya treatment and papain extraction group.

Other viable industries that have inquired for information with interest as a user, include (1) greenhouse farming, (2) aquaculture farming, (3) manufacture of pelletized feed in aquaculture, (4) seaweed drying and processing, (5) sterilization of media and soil for mushroom and ginger and (6) a support facility (store).

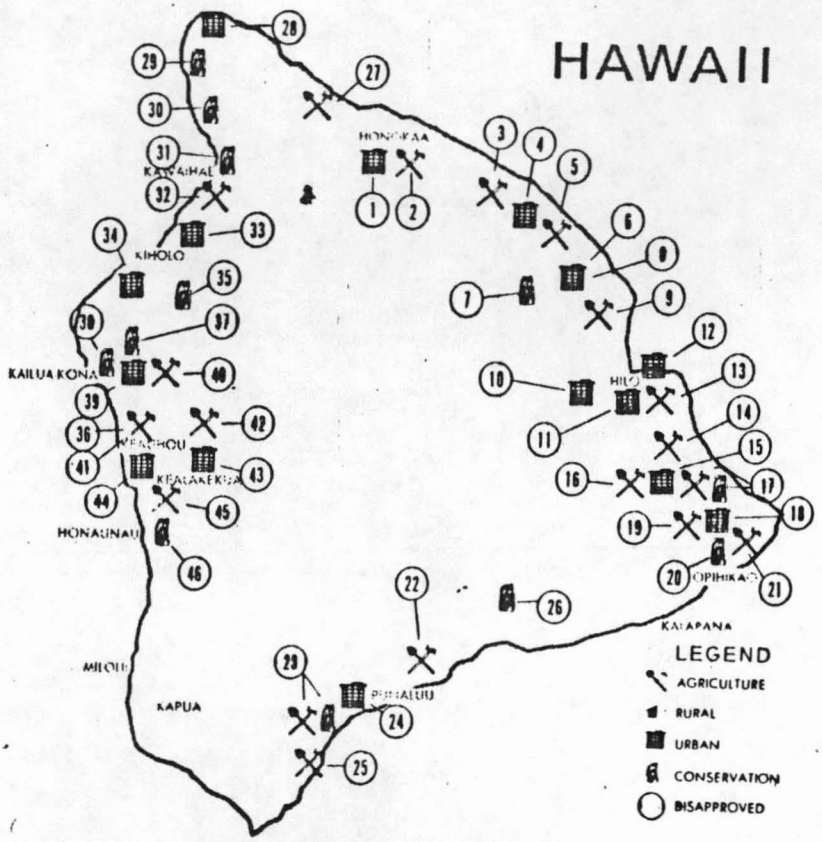
It is the intent of the applicant to make a proven high-temperature geothermal resource reservoir available for exploratory drilling and to expand geothermal energy for use into the neighboring subdivided parcels. Portions of the property will be dedicated to research and development facilities to develop and improve agriculture and aquaculture industries and to research into other non-polluting industries that would benefit the County and the State.

The support and dedication for a renewable alternative energy resource would decrease our dependency on imported petroleum. This search must be maintained if we are to avoid economic and social upheavals when imported petroleum is disrupted or priced too high.

This application, together with 5 copies (3 required) and a $100 application fee, is herein submitted for your kind attention and consideration.

INTEGRATED RESOURCES, INC.

Land use decisions



Here is a summary of Big Island land use zoning changes voted upon yesterday by the State Land Use Commission (numbers match the numbers on the map):

1. Honokaa, 238 acres from agricultural to urban; approved.

2. Honokaa, 90 acres from urban to agricultural; approved.

3. Paauilo, 13 acres from urban to agricultural; approved.

4. Paauilo, 40 acres from agricultural to urban; approved.

5. Kukaiau, five acres from urban to agricultural; approved.

6. Papaaloa, 140 acres from agricultural to urban; approved.

7. Laupahoehoe, 120 acres from agricultural to conservatiion; approved.

8. Ninole, 23 acres from agricultural to urban; disapproved.

9. Pepeekeo, five acres from urban to agricultural; approved.

10. Hilo, 157 acres from agricultural to urban; approved.

11. Hilo, 40 acres from agricultural to urban; approved.

12. Waiakea Homesteads, 325 acres from agricultural to urban; approved.

13. Keaukaha, 110 acres from urban to agricultural; approved.

14. Keaau, three acres from urban to agricultural; approved.

15. Kurtistown, one acre from agricultural to urban; approved.

16. Mt. View, 35 acres from urban to agricultural; approved.

17. a. Kapoho, 110 acres from urban to agricultural; disapproved. b. Kapoho, 40 acres from urban to conservation; disapproved.

18. Pahoa, five acres from agricultural to urban; approved.

19. Pahoa, four acres from urban to agricultural; disapproved.

20. Nanawale, 17 acres from agricultural to conservation; approved.

21. Nanawale, 40 acres from conservation to agricultural; approved.

22. Pahala, 351 acres from urban to agricultural; approved 261 acres only.

23. a. Ninole, 120 acres from urban to agricultural; disapproved. b. Ninole, 100 acres from urban to conservation, disapproved.

24. Punaluu, one acre from conservation to urban; approved.

25. Naalehu, 94 acres from urban to agricultural; approved.

26. Kapapala, 15,600 acres from agricultural to conservation; approved.

27. Kukuihaele, 12 acres from urban to agricultural; approved.

28. Hawi, 14 acres from agricultural to urban; approved.

29. Lapakahi, 300 acres from agricultural to conservation; approved.

30. Kohala, 737 acres from agricultural to conservaton; approved.

31. Hapuna, 185 acres from urban to conservation; approved. b. Hapuna, 325 acres from agricultural to conservation; approved.

32. Waikoloa, 1,100 acres from urban to agricultural; disapproved.

33. a. Waikoloa, 724 acres from agricultural to urban; partially approved — 252 urban, 472 agricultural. b. Makaiwa, 362 acres from conservation to urban; approved.

34. Kaupelehu, 318 acres from conservation to urban; approved.

35. Puu Waawaa, 2,100 acres from agricultural to conservation; approved.

36. a. Keauhou, 21,650 acres from conservation to agricultural; approved.

b. Keauhou, 9,000 acres from conservation to agricultural; approved.

37. Kaloko-Honokohau, 622 acres from urban to conservation; disapproved.

38. Kealakehe, 650 acres from urban to conservation; disapproved.

39. Kealakehe, 248 acres frm agricultural to urban; approved.

40. Kealakehe, 10 acres from urban to agricultural; disapproved.

41. Kahului Puapuaa, 280 acres from urban t agricultural; disapproved.

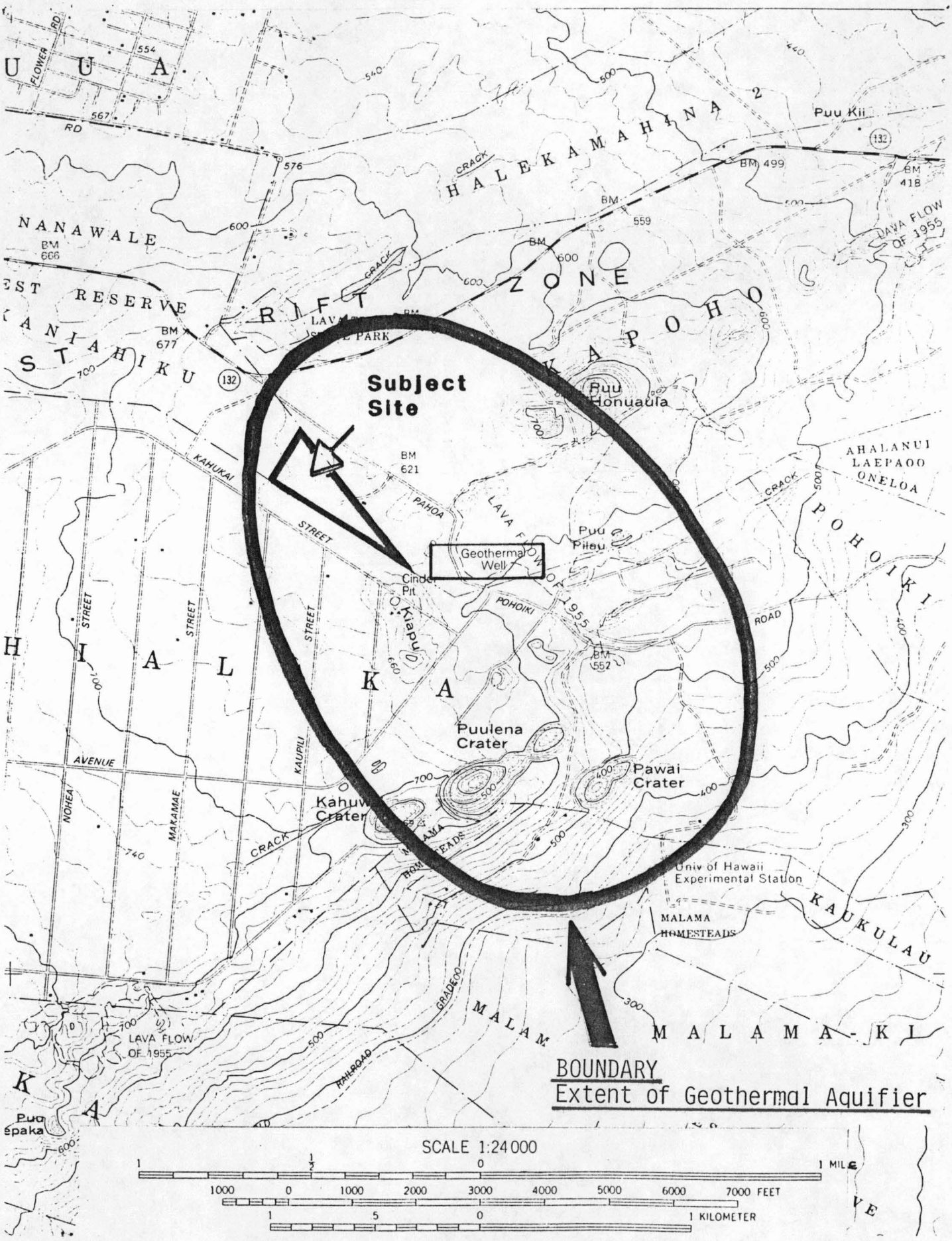
42. Holualoa, 26 acres from urban to agricultural; disapproved.

43. Holualoa, 1 acre from agricultural to urban; approved.

44. Keauhou, 838 acres from agricultural to urban; disapproved.

45. Kealakekua, 140 acres from urban to agricultural; disapproved.

46. Keei, 32 acres from urban to conservation; approved.



TOPOGRAPHIC MAP OF SITE

RULES AMENDING TITLE 13
ADMINISTRATIVE RULES
August 24, 1984

CHAPTER 184 is amended

Designation and Regulation of Geothermal Resources Subzones

SUBCHAPTER 2

Designation of Geothermal Resources Subzone

SECTION 13-184-5

Landowner Initiated Subzone Designation

District of Puna

Island of Hawaii

June 20, 1988

INTEGRATED RESOURCES, INC.

HONOLULU, HAWAII

BOARD OF LAND AND NATURAL RESOURCES

State of Hawaii

PROPOSED GEOTHERMAL RESOURCES SUBZONE

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TABLE OF CONTENTS

FOR THE BOARD OF LAND AND NATURAL RESOURCES

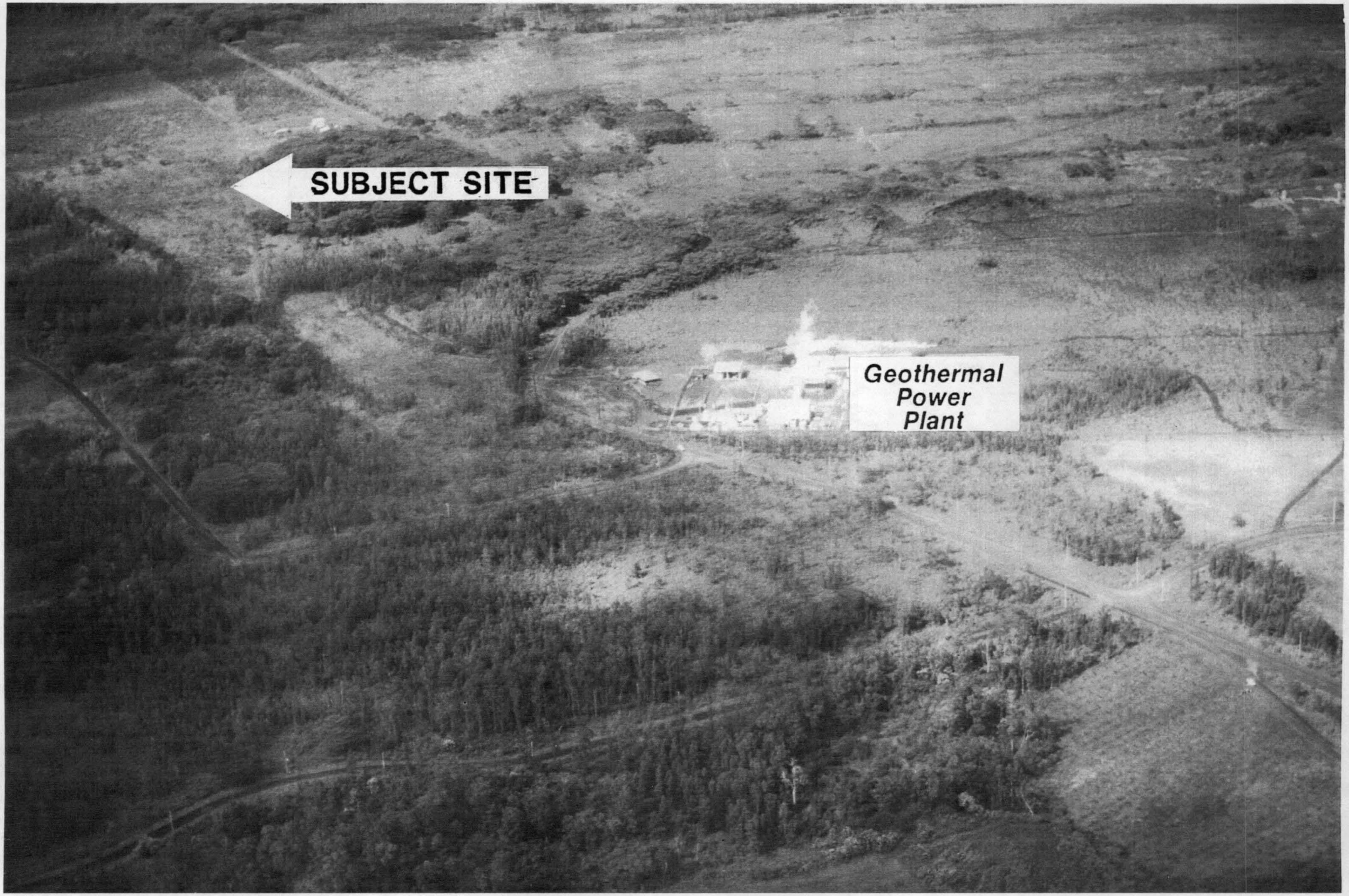
OF THE STATE OF HAWAII

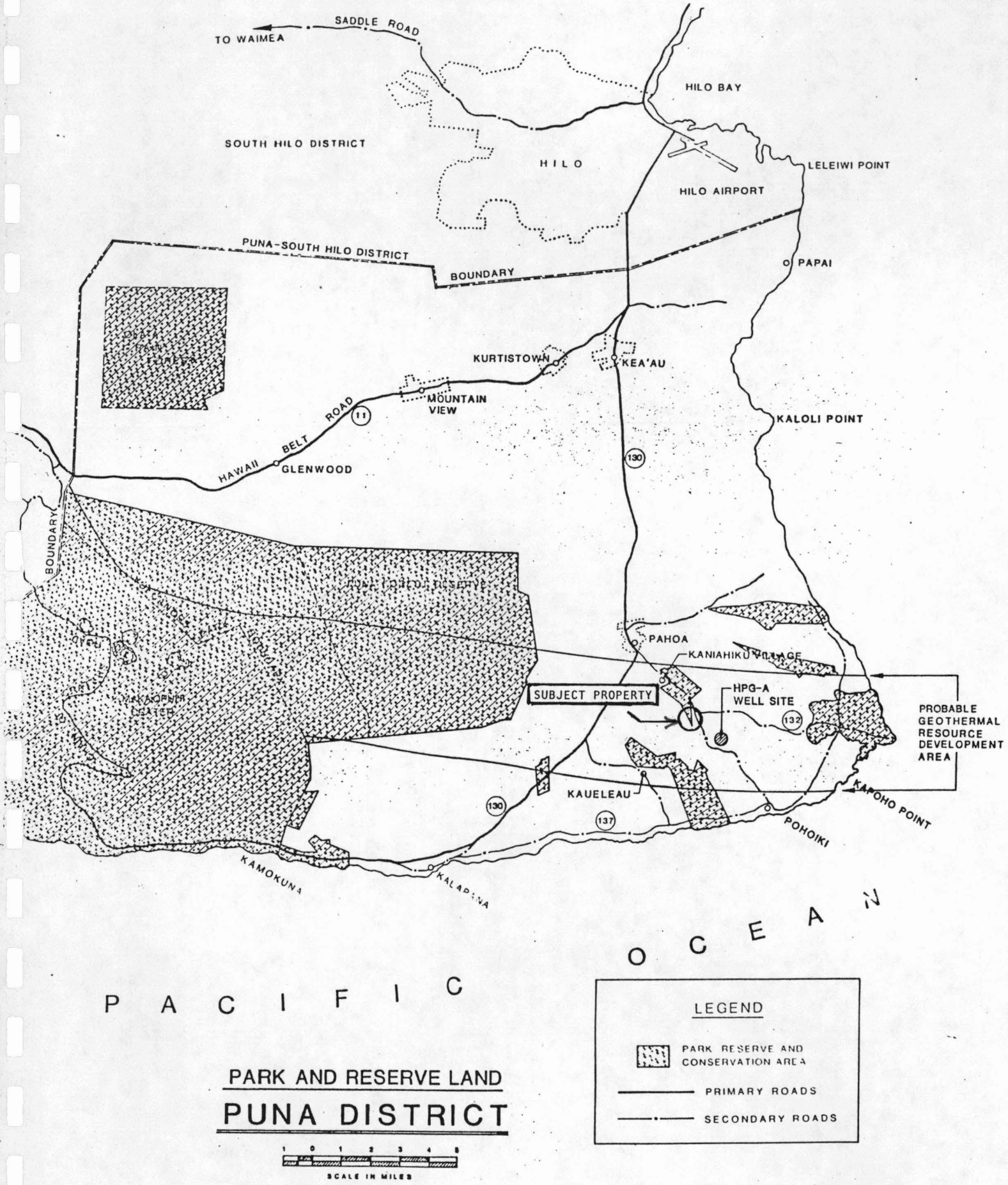
APPLICATION FOR GEOTHERMAL RESOURCES DESIGNATION

This application brought persuant to Title 13, Department of Land and Natural Resources, Sub-Title 7, Water and Land Development, Chapter 184, Designation and Regulation of Geothermal Resource Subzones, Subchapter 2, Designation of Geothermal Resource Subzones, Section 13-184-6, Criteria for Designation of Subzones;

(a) to designate 40.367 acres of land situated at Pohoiki Bay Estates, District of Puna, Island of Hawaii, County of Hawaii, to a Geothermal Resource Subzone. This designation is being sought to permit geothermal development activities, in addition to those uses permitted in each land use district under Chapter 205, Hawaii Revised Statutes.

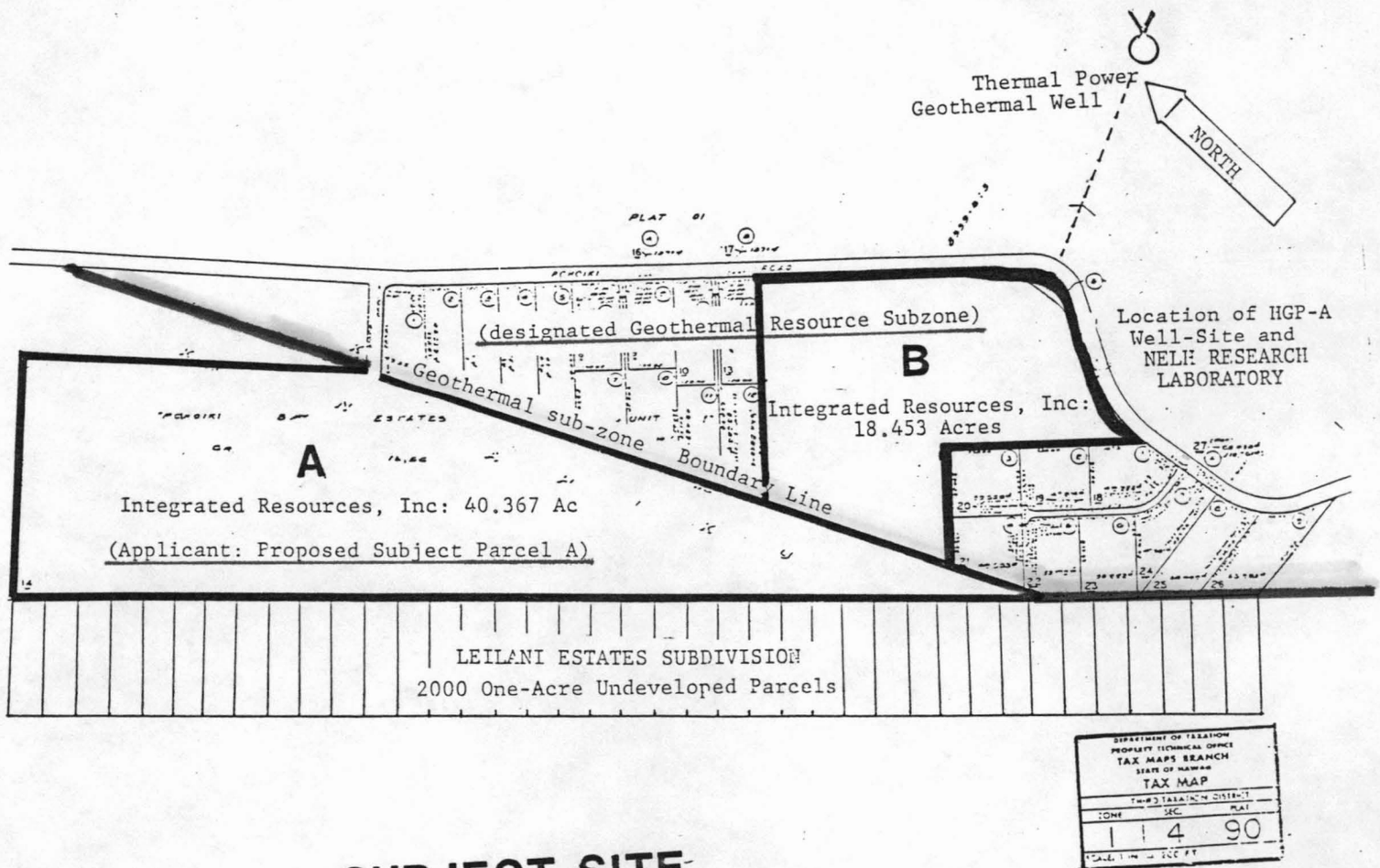
(b) to consolidate applicant's Proposed Subject Parcel A (40.367 Acres) to the abutting applicant's Parcel B (18.453 Acres designated Geothermal Resources Subzone), creating a 58.82 Acre parcel for geothermal resources development and resources permitted uses.


SUBJECT SITE
Geothermal
Power
Plant



PARK AND RESERVE LAND

PUNA DISTRICT



SUBJECT SITE

All correspondences and communications concerning this application are to be address to Integrated Resources, Inc., Suite 211, 535 Ward Avenue, Honolulu, Hawaii, 96814.

1. Identification of Applicant.

The applicant is Integrated Resources, Inc., a Hawaii corporation, incorporated in the State of Hawaii, with principal place of business situated at Suite 211, 535 Ward Avenue, Honolulu, Hawaii, 96814. The applicant is a company engaged in business since 1973. It is the fee owner of a number of condominium apartments in Honolulu, Hawaii as well as duplexes in Pearl City, Hawaii. Holdings on the island of Hawaii include Proposed Subject Parcel A (40.367 Acres) and adjacent Parcel B (18.453 Acres) and two contiguous parcels identified as Tax Map Key: 1-4-90-1 and 13.

Applicant's proposed subject parcel held on the Island and County of Hawaii is held in Fee Simple subject to reservation in favor of the State of Hawaii of all mineral and metallic mines as reserved in Royal Patent No. 4497, Rights of native tenants as contained in said Royal Patent No. 4497.

2. Applicant's Proprietary Interest In The Property.

Property was purchased by applicant in 1972, under a limited partnership, of which applicant was the general partner. Property was held for eight (8) years and sold to a land developer in 1980. The developer subdivided the property and sold a number of parcels before defaulting on

the mortgage.

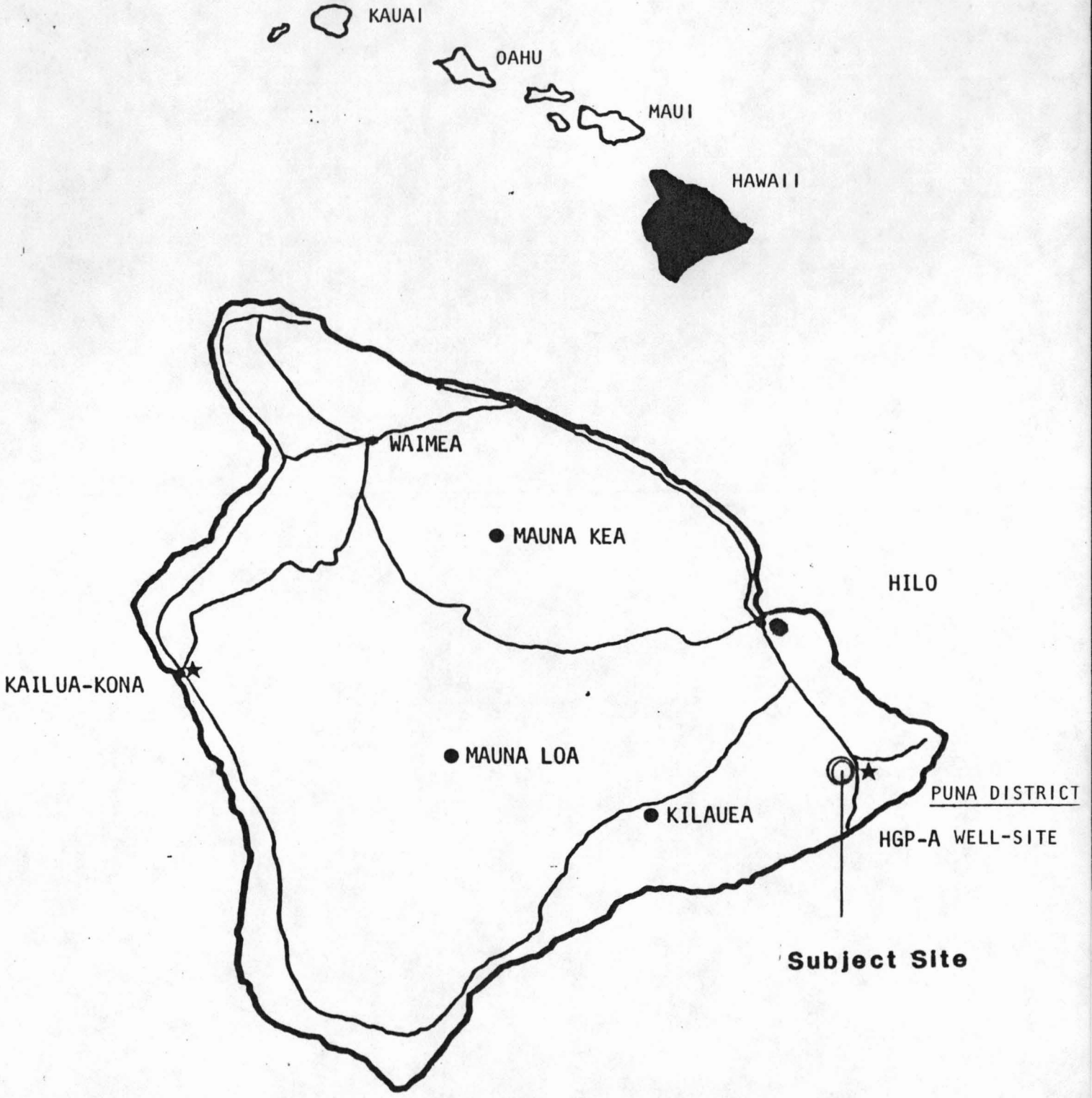
In 1985, the property reverted back to the limited partnership and mortgagee and the property was partioned for liquidation and distribution to the partners in the limited partnership.

Applicant, Integrated Resources, Inc, is the fee simple owner of the proposed subject parcel which was transferred to the applicant's own corporation, Integrated Resources, Inc. Control and ownership of the Proposed Subject Parcel has been over a fifteen (15) year period.

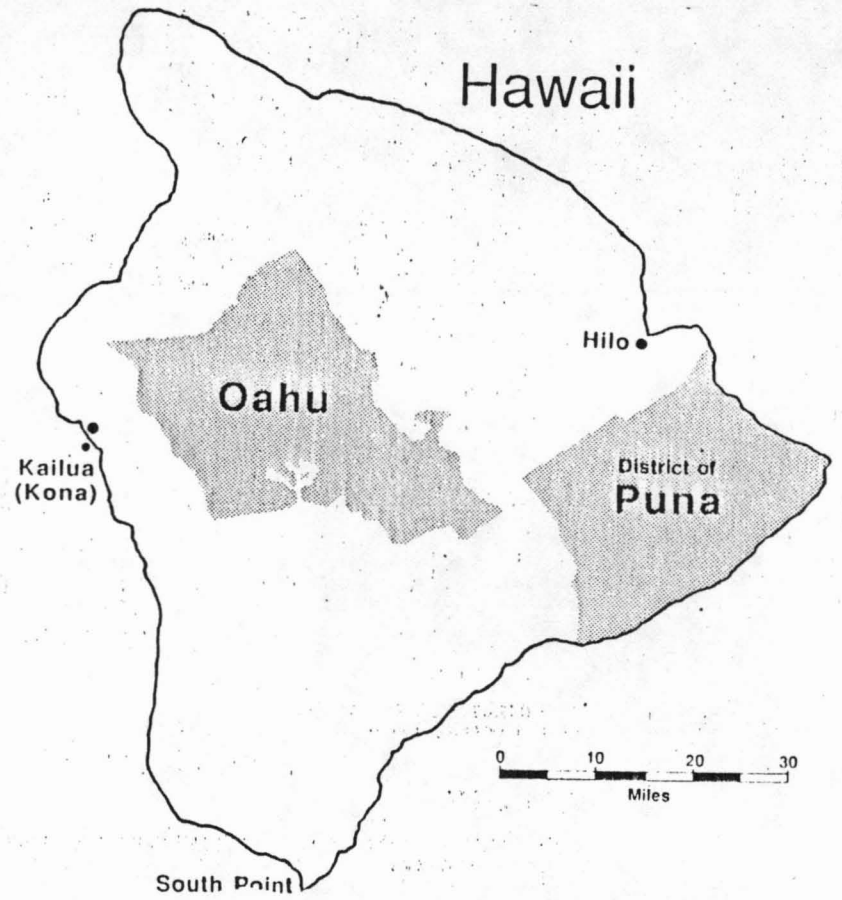
3. Location of Proposed Subject Property.

The property is located on the Island of Hawaii in the Puna District. The parcel contains an area of 40.357 acres as part of Pohoiki Bay Estates, Unit I, being a portion of Land Patent 8177 on Royal Patent 4497, Land Commission Award 8559-B, Apana 5 to C. Kanaina.

The subject parcel is situated north and westerly of the University HGP-A Well-Site and east of the Leilani Estates Subdivision boundary. Proposed Subject Parcel is approximately 4 miles southeast of Pahoa town and located an estimated 17 miles from the town of Hilo. The parcel has a makai boundary, westerly of Pohoiki Road, of 3,425 feet adjacent to Leilani Estates Subdivision with a declining irregular width of approximately 807 feet. Access to the subject parcel is a 60 feet wide roadway, 300 feet in length located at the northern end of the subject property.

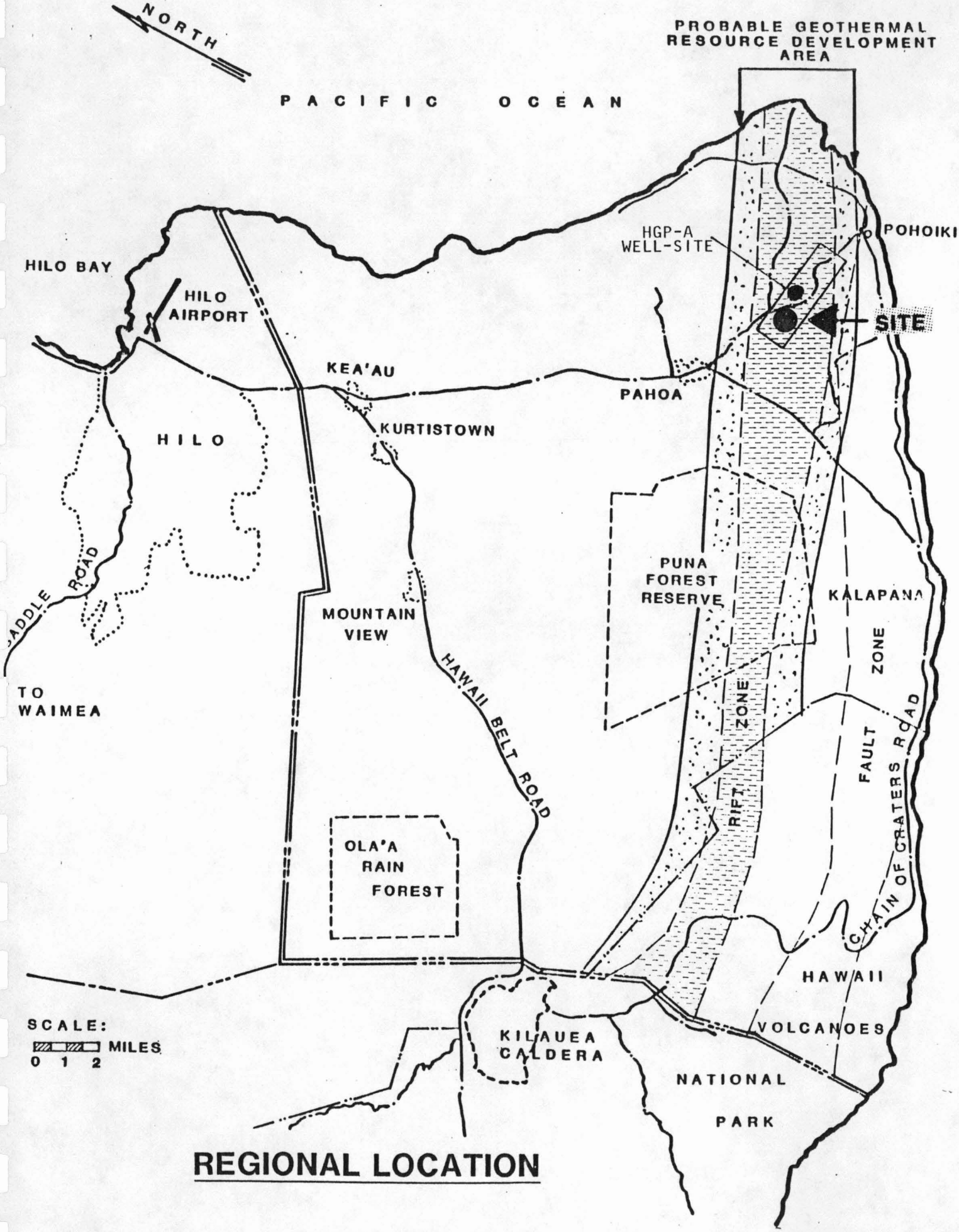


SITE LOCATION



Puna is nearly as big as Oahu, here shown to scale.

ISLAND LOCATION



REGIONAL LOCATION

3a. Physical Description Of The Property.

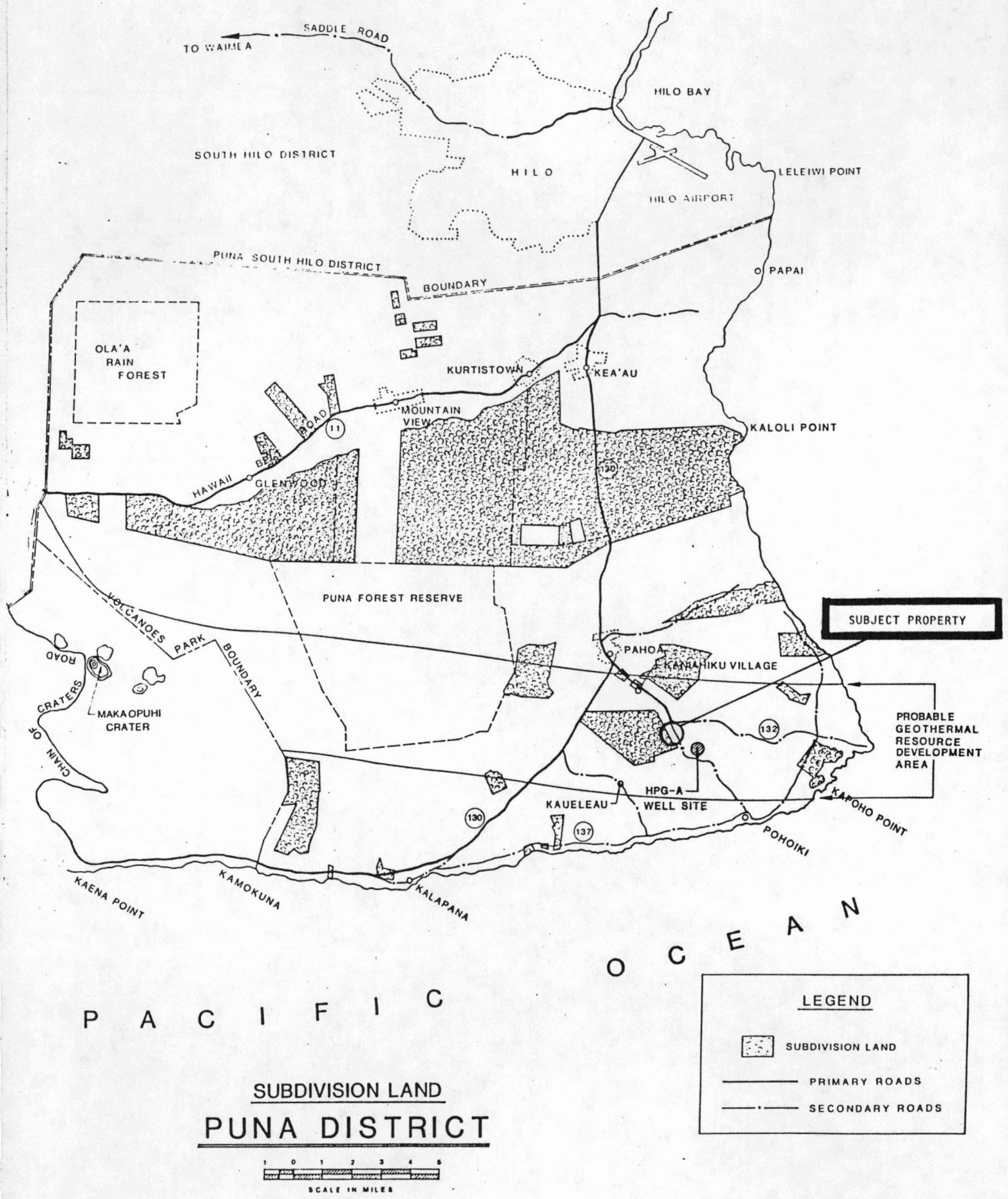
The proposed subject parcel is situated to the immediate north and west of the University's Hawaii Geothermal Project-Abbott (HGP-A) Well-Site, a successful demonstration geothermal power plant.

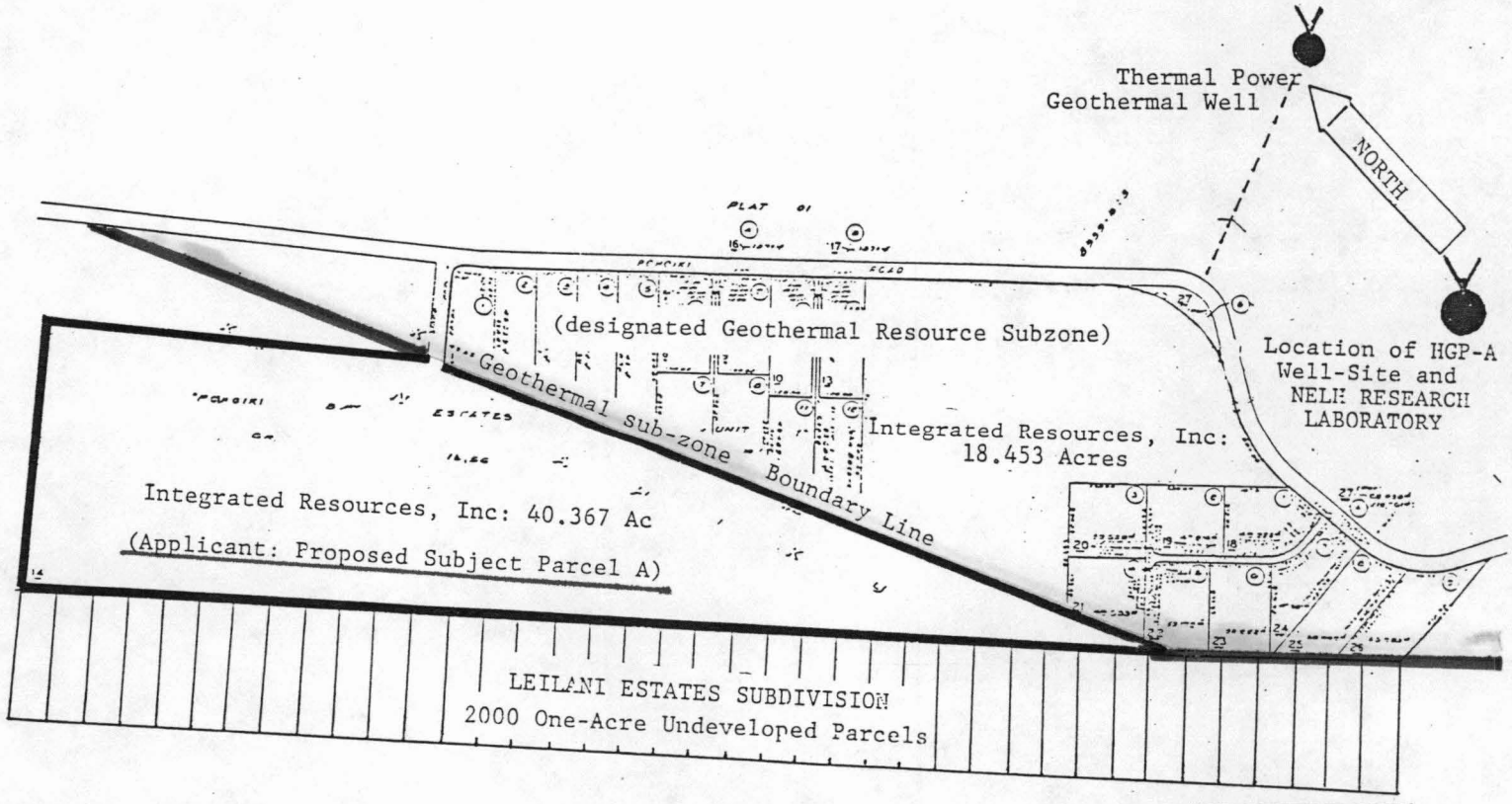
The proposed property is triangular in shape, the west border abutting Leilani Estates Subdivision, a one-acre agricultural subdivision. The proposed subject parcel has been cleared and graded and used as a papaya farm . The terrain is level and the area annual rainfall is in excess of 120 inches with winds moving in a southerly direction. The land is very permeable and overland water run-off is absent due to aa lava composition.

Soil Condition. The ground is composed of the Aa lava and having no growth medium and unsuitable for growing of papaya. Evidence of larger lava clinkers makes it difficult for machinery tilling. Low papaya production of planting in 1983 was the last agricultural crop attempted on the property.

The adjacent applicant's Parcel B, located abutting Pohoiki Road and designated Geothermal Resource Subzone, is rich in growth medium. The land is covered with vegetation and trees that exceed sixty (60) feet in height. No archaeological sites or features of sites are to be found either within or immediately adjacent to the boundaries of the proposed subject parcel.

A small cinder-cone site is located near the southern end of the proposed subject parcel, however, the quality and quantity of the cinders does not warrant commercial harvesting.


SADDLE ROAD
TO WAIMEA
HILO BAY
SOUTH HILO DISTRICT
HILO
LELEIWI POINT
HILO AIRPORT
PUNA SOUTH HILO DISTRICT
BOUNDARY
PAPAI
OLA'A
RAIN
FOREST
KURTISTOWN
KEA'AU
MOUNTAIN
VIEW
KALOLI POINT
HAWAII BELT ROAD
GLENWOOD
PUNA FOREST RESERVE
VOLCANOES PARK BOUNDARY
SUBJECT PROPERTY
PAHOA
KAHAIHIKU VILLAGE
ROAD
CRATERS
MAKAOPUHI
CRATER
CHAIN OF
PROBABLE
GEOTHERMAL
RESOURCE
DEVELOPMENT
AREA
HPG-A
WELL SITE
KAUELEAU
KAPOHO POINT
POHOIKI
KAENA POINT
KAMOKUNA
KALAPANA
PACIFIC OCEAN
LEGEND
SUBDIVISION LAND
PRIMARY ROADS
SECONDARY ROADS
SUBDIVISION LAND
PUNA DISTRICT
1 0 1 2 3 4 5
SCALE IN MILES



TAX MAP WITH SUBJECT SITE

4. Statement By Applicant for the Purpose, Justification and Need for Geothermal Resource Designation.

Purpose for Geothermal Resource Subzone Designation.

(a) To create an economically viable parcel of land realized when applicant's two contiguous parcels are unified under one land use designation as a Geothermal Resource Subzone in an area indicating promise for high-temperature geothermal resources, that can be utilized as a geothermal resource development area or used to supply industries that would use geothermal fluids and steam.

(b) In granting the Geothermal Resources Subzone Designation and making potential geothermal resource land available to both geothermal resource development and the use of geothermal fluids and steam on the premises, the utilization would be consistent with both State and County goals to increase Hawaii's energy self-sufficiency, reduce the State's reliance on imported fossil fuels and to develop and use renewable energy resources.

(c) Within the Kilauea East Rift Zone, where the Proposed Subject Parcel is located, lands have excellent indications of useable high-temperature geothermal resources. By the consolidation of applicant's Parcels A and B, it would create a 58.81 acre parcel which would be large enough to support dispersed geothermal wells necessary to supply a electric generating plant. Approximately nine (9) producing geothermal wells would be required to support a 25 megawatt

electric generating plant and eleven (11) make-up or replacement wells over the thrity-five (35) year life of the project. This amount of electricity would be to supply the Island of Hawaii for its island-wide use only. Also, residual steam from the electric generating plant would be in adequate supply to be utilized in the immediate area to support geothermal fluids and steam related industries.

Justification for Geothermal Resource Subzone Designation.

(a) Geothermal Resource Availability. Thousands of acres of land are designated as Geothermal Resource Subzones, however, technical and innovative tests conducted in the recent years, have indicated geothermal resource to be located in a precise location. The University HGP-A well-site was selected using geochemical and electrical studies of the area. Test drillings were made in various regions and its findings together with supporting analyses to conclude the location where the HGP-A demonstration project be located.

The success of the HGP-A geothermal demonstration project is reinforced and supported by subsequent test drilling made by private developers. Numerous unproductive exploratory wells were drilled at great expense and eventually led to abandonment which have contributed to the loss of momentum in geothermal development in Hawaii. Well-sites must be in area that show greatest potential in high-temperatures resources and wells must be drilled where the resources are located. Before any exploratory activities can be made, the land must be

in a designated Geothermal Resources Subzone.

Commercial quality, quantity and high-temperature geothermal resources have proved difficult to locate. The sector or anomaly where this aberration occurs has been scientifically determined as being the most likely location for success and played a role in determining the HGP-A Site. This area in the Kilauea East Rift Zone is where the Proposed Subject Parcel is located. The HGP-A well supports all studies made by producing the hottest geothermal well in the world with temperatures of approximately 676 degrees Fahrenheit with adequate supply of resource to support a 3 megawatt electrical generator.

Until recently, ninety percent (90%) of the residual steam, steam that leaves the electric generating plant, is wasted, until a research facility was instituted to develop geothermal related industries. Physical space limitations on the four (4) acre HGP-A demonstration site severely limits the scope of trials and experiments by entrepreneurs that have participated in the project to utilize residual steam and geothermal fluids.

With the exception of Thermal Power Company, exploratory drilling have not taken place in the selected sector or anomaly of the HGP-A site. Exploratory well drillings by Thermal Power Company in the area close to the sector is reported to be of high quality, however, information is proprietary.

(b) Location and Topography. In addition to geothermal resource availability, location of the Proposed Subject Parcel makes it the only large parcel located in the prime sector or geothermal anomaly in which the HGP-A well-site is located.

Pohoiki Road separates the HGP-A well-site location and the applicant's 58.82 acre proposed consolidation parcel. Consolidation is anticipated only after the granting of Geothermal Resource Designation of Proposed Subject Parcel A containing 40.367 acres. Proposed Subject Parcel would then be consolidated with applicant's adjacent Parcel B containing 18.453 acres to form a 58.82 acre parcel with geothermal resources designation which would allow the exploration of geothermal resources and the use of geothermal fluids and steam which could be made available from the nearby HGP-A geothermal demonstration project or from residual steam from anticipated geothermal well-sites located within the Proposed Subject Parcel.

The Proposed Subject Parcel combined with the applicant's adjacent Parcel B forming a 58.82 acre parcel with proposed Geothermal Resource Designation would also be a potential user of residual steam from the planned electrical generating plant proposed by Thermal Power Company that is to be located in the immediate vicinity of their geothermal well-site across Pohoiki Road and situated North of the HGP-A well-site demonstration project.

Ground surface area of a geothermal resource field should be large enough to accomodate the dispersement of a number of geothermal wells to ensure a sufficient supply of geothermal energy to the electric generating plant. The economic factors of high-temperatures and amount of energy available would be major considerations before a generating plant is built. Earthquakes and seismic disruptions will not likely result in damage to installations, except when the well-bore could be disrupted should the fracture intersect the well-bore and seal off the resource. By the dispersement of well-bores and well sites, this would insure the unlikely prospect of disruption of geothermal resources and insure a continuous supply to the electrical generating plant.

A large surface area would also support industries that require surface installations such as aquaculture ponds and agricultural fields or greenhouses. These non-electric producing industries would use the residual steam from the electrical generating plants, in addition to being clean, non-polluting industries.

Due to the complexities of underground dikes and faults, a number of wells drilled would not result in high-temperature, quality producing geothermal wells. As an alternative, these wells could still result in producing geothermal fluids for geothermal related industries. Steam could be produced in a closed circuit system that could be utilized in drying and

processing feed pellets for aquaculture; also, steam flashing and hot water treatment of papayas for overseas shipment. There are numerous applications for steam in industries that would justify industries locating close to the geothermal electrical generating plants where the residual steam is available for their use.

The Subject Parcel is located close to Pohoiki Road and has available electrical lines with water service available to the parcel. Geothermal fluids and steam is available at the HGP-A well-site, however, it must be transported over Pohoiki Road into the Subject Parcel. Special permits and applications must be made for steam to cross a roadway and it may involve both time and expense.

The Proposed Geothermal Resource Designation may eliminate the need to transport steam across Pohoiki Road. Geothermal resources may be available on the Subject Parcel and would be available for both, the production of electricity and residual steam for industrial use on the property.

Need For Geothermal Resource Subzone Designation.

(a) Potentially Rich Geothermal Resource Lands would become available for exploration. The geothermal industry is now being faced with growing opposition from environmentalists with legal challenges, compounded with a lack of public interest and lower oil prices that have forced re-evaluation within the geothermal industry. Geothermal Resource Designation to the Proposed Subject Parcel in Puna would

make potentially rich and promising geothermal lands available for exploration to produce non-fossil fuel electricity and to supply geothermal-related industries with a source of residual steam in the immediate area. With a Geothermal Resource Subzone Designation, lower temperature geothermal fluids could be used to heat a closed system of steam production and used to either process fruits or in direct heat applications industries such as heated aquaculture ponds. Heat-exchange technology to create lower temperatures could be utilized to regulate temperatures in greenhouses to grow crops requiring lower temperatures such as strawberries and asparagus.

The Geothermal Resource Subzone Designation would make the area a potential industrial site that could accomodate the demonstration projects by entrepreneurs that are presently working on their expertise in the NELH facility located adjacent to the HGP-A well-site. There is a need for a small industrial park in the immediate area, close to the geothermal fluids. Although industrial sites are being considered several miles away, outside of the rift zone, cost of transporting the geothermal fluids and of developing the infrastructure including utilities would be great.

There is demand for industrial land close to where geothermal fluids and steam energy are located with access to electricity and water. Road access must also be addressed together with site improvements and development.

The Natural Energy Laboratory of Hawaii, NELH, manages the HGP-A Demonstration Project in Puna, including the sponsored projects where entrepreneurs are encouraged to participate in developing uses for residual steam and other by-products of the geothermal resource. Projects included textile dyeing, aquaculture and agriculture experiments that were affected by different temperatures in the growth and crop production, sterilization of growth medium affecting ginger growing and mushroom production, steam used to dry lumber products and a host of various experiments. These projects, once completed, must relocate and begin commercial production near the geothermal fluids and steam.

Affordable sites near the geothermal well-sites would be the most logical choice. The amount of geothermal fluids and steam available for entrepreneurs and industries to use will determine the size of affordable industrial space. Other requirements would include accessibility to roadways, utilities and support facilities. Otherwise, entrepreneurs may abandon their projects and hopes for successful new industries.

As the concern for reliance on fossil fuel for electricity production and its effect on the environment, creating a "greenhouse effect", is intensified, the development and use of geothermal resources must be fully explored and utilized. Every avenue for exploration and discovery must be opened and made available to the developer of geothermal energy

for electricity generation and industrial uses.

The Proposed Subject Parcel is in a proven geothermal resource sector or anomaly, with a successful HGP-A demonstration project, producing approximately three (3) megawatts of electricity annually. A Geothermal Resource Subzone Designation would permit exploration for geothermal resources and the use of geothermal fluids and steam that are already available in the immediate area. Also, test drillings in various areas confirm the location of high-temperature geothermal resources in the anomaly in which the Proposed Subject Parcel is located.

This area of under-developed, affordable one-acre parcels would be available to entrepreneurs both as residences and as supporting areas to the industrial sites. It is conceiveable that geothermal energy could be used to desalinate brackish water for use in the immediate areas and other geothermal fluids to heat water for residential use. Possibilities for use of a lower cost energy source could be realized by establishing research and development facilities in the immediate area.

Only a few large parcels are available in the immediate area that is located close to the HGP-A Well-Site that could become the conduit to developing and utilizing the smaller one-acre agricultural parcels.

ASSESSMENT REPORT

Based On Criteria For Designation of Geothermal Resources Subzones Section 13-184-6 of Chapter 184 as Amended

(1) Area Has Potential For Geothermal Development Activities.

Geothermal Assessment. The geochemical and geophysical data acquired on the Kilauea East Rift Zone by the Hawaii Geothermal Resources Assessment Program initiated in 1978, under the Western States Cooperative Direct Heat Resources Assessment Program has identified the area as a Known Geothermal Resource Area (KGRA). The area of the HGP-A well was drilled upon the completion of a set of geophysical and geochemical surveys which had yielded that subsurface thermal anomalies were present. Production of geothermal fluids at HGP-A has proved that the fluids are associated with the Kilauea East Rift Zone. Four additional deep wells were drilled within the rift area and although majority of the data generated by these wells is proprietary, it has been reported that all of the wells have encountered temperatures greater than 200 degrees centigrade, however, only two wells have achieved economically viable production rates. The unsuccessful wells associated with insufficient volumes of steam has proved that economically viable production wells can only be determined by drilling and testing a deep exploratory well and present techniques must be confirmed by actual drilling of a deep exploratory well in the Kilauea East

Rift Zone and that commercially valuable quantities of steam can be produced from the geothermal system associated with the Kilauea East Rift Zone. These findings are confirmed with the successful demonstration project at the HGP-A Well-Site. The volume of the heated geothermal fluids determines the commercial value of the resource which can be found in the Kilauea East Rift Zone. The HGP-A Well is a proven geothermal resource reservoir and has produced electricity over several years. The Proposed Subject Property is located in the same anomaly as the HGP-A Well and a Geothermal Resource Designation would make the area available for additional geothermal resource exploration in addition to making the land available for the use of geothermal fluids from producing wells already drilled and having high temperatures. These wells include the HGP-A Well and that drilled by Thermal Power Company.

(2) <u>There is Known or Likely Prospect For The Utilization of Geothermal Resource For Electrical Energy Production.</u> The temperature of subsurface area could be identified and confirmed with shallow test drilling, however, technology is not available to measure the availability of geothermal fluids and steam. Deep drill tests, although expensive, is the only reliable method which the geothermal development program depends upon. However, the sector or anomaly in which the high-temperature geothermal fluids occur has been proven to be 100% effective. Until technology is developed, expensive deep-well drilling must be made in the most promising location.

Areas within the Kilauea East Rift Zone have been isolated as having high subsurface temperatures. The area where the HGP-A Well-Site is located was chosen as being the most promising. Within the area of the HGP-A Well-Site, adequate land is not available, but by consolidating the applicant's Parcels A and Parcel B, forming 58.82 acres, there would be sufficient land to drill a number of wells needed to support the volume of geothermal fluids that would be required to produce electricity economically. Presently, only Parcel B is within the Geothermal Resource Subzone with Parcel A being under this application. Service and support facilities that include electricity, water and roadways are all located in the immediate area.

(3) Potential Geologic Hazards to Geothermal Electricity Production Or To Geothermal Resource Use In The Proposed Area. The Proposed Subject Parcel for Geothermal Resource Subzone Designation is in the Kilauea East Rift Zone. There are two (2) categories to geologic hazards within the rift zone. First, there is the elevation or downslope gravitational movement of lava in a volcanic eruption. Second, subsidence and ground movement and settlement which would occur. Incidence of subsidence would occur more likely to the South of the Kilauea East Rift Zone, similar to the 1975 Kalapana disruption whereby large areas were sunken or depressed.

Elevation Causing Downslope Movement of Lava. Although still within the Kilauea East Rift Zone, the Proposed Subject

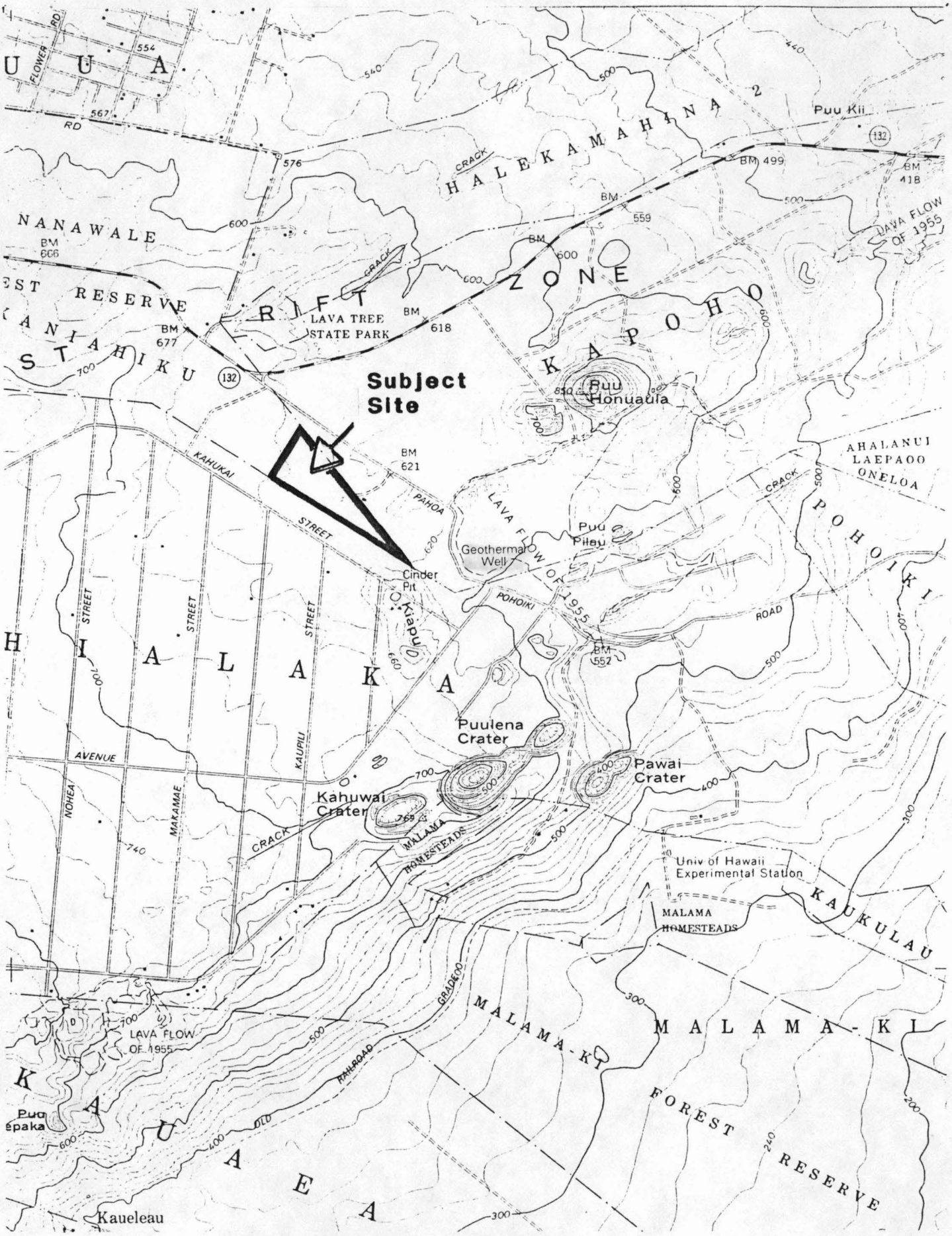
Parcel is located in an area of elevated ground, relative to the HGP-A Well-Site location. It would be unlikely that physical facilities would become engulfed by a lava flow.

Very viscous lava or large chunks formed in a lava flow could possibly dislodge or dislocate pipelines, however, it is unlikely that normal fluid lava flows would damage pipelines that are located on the ground surface or anchored with concrete. As a precaution, pipelines could be buried in trenches or covered in sloping mounds.

Pipelines are designed with expansion joints to accomodate the expansion and contraction caused by internal heated fluids such as in geothermal fluids. Expansion joints would decrease the damage effects of a normal fluid lava flow. Additional anchoring and contouring of protective barriers would minimize damage to pipelines and physical structures.

Subsidence, Ground Movement and Earthquakes. Proposed Subject Parcel A is located North of the HGP-A Well site and it would be unlikely that subsidence would occur. Earthquakes will probably not result in damage to the wells and to specially fitted pipelines with expansion joints, except that the well-bore could be disrupted should a fracture caused by an earthquake intersect the well-bore and seal off the geothermal resource and disrupt the continuous supply of geothermal fluids used to generate electricity.

Dispersement of well-bores would eliminate the interruption of geothermal fluids to a generating plant. Surface land



TOPOGRAPHIC MAP OF SITE

area would be required to properly disperse the number of well-bore sites within the geothermal field. Dispersement will be accomodated only by the location of geothermal resources with spacing within a geothermal heat reservoir.

(4) Environmental Or Social Impacts of The Geothermal Resources Development Within The Proposed Area. Within the Proposed Subject Parcel Area, which includes the present HGP-A Well-Site, the NELH Research Laboratory, a three (3) Megawatt Electric Generator and a private geothermal well-site, environmental and social impact has been minimal. Noise levels were monitored and noise abatement fixtures installed to further minimize sound levels. Hydrogen Sulfide gas emission were measured and determined to be within the safety range by the Hawaii State Department of Health. Studies of ground water and coastal springs identifies thermal fluids infiltrated into the system with water well temperatures in excess of 90 degrees centigrade. It is theorized that the lens of thermal fluids and warm water float on the cooler ground water base and discharged to the ocean at coastal thermal springs. Other environmental considerations made were the presence of acceptable levels of mercury and radon. Heavy metal residue in trace amounts were found in the Puna District in a study conducted by the Pacific Biomedical Research Center, University of Hawaii at Manoa. Baseline surveys for Mercury vapors and Hydrogen Sulfide gas are mandated for annual report to the Department of Health.

Social impact on the sparse population in the Puna District would be very significant. Community surveys and interviews conducted with local leaders of the Hawaiian community regarding the development of Geothermal Resources in lower Puna revealed many deep concerns and fears.

Anticipated changes expressed include population increase and related stresses, also economic benefits and availability of community services. Changes in ethnic composition of the area leading to erosion of Hawaiian heritage and customs and loss of the status quo are some of the other concerns.

Positive aspects of the study includes local ownership of business related to geothermal energy, getting better jobs with greater economic benefits. There are hopes for lower electricity rates and a better understanding and relationships between entrenched local population and newcomers to the area.

The community seems to have approved of geothermal development with strong reservations. These reservations focus on community demands for controlled and planned economic development benefits to local community and the development that would cause the least damage to their lifestyles and to their rural environment.

Wildlife or Endangered Species. Perusal of publications and studies indicate no negative impact on wildlife or to endangered species that may occur in the immediate area. The Hawaiian Hawk or Io, Buteo solitarius, is known to exist on the Kona Coasts of Mauna Loa, however, observations of the

specie could not be confirmed in the Puna District or in the immediate area of the Proposed Subject Parcel.

Introduced Birds. The impact of noise and habitation from geothermal development on the bird population is of significance. Species of birds in the immediate area include pigeons and doves, Geopelia striata and Streptopelia chinesis, more commonly known as the laced-neck dove. The Japanese White-Eye or Zosterops japonicus are observed infrequently as well as the Indian Mynah, Acridotheres tristis. The House Finch, Carpodacus mexicanus frontalis, is usually found in papaya farms and some sightings of the Cardinal, Cardinalis cardinalis have been made in the immediate area.

Seabirds and migratory shorebirds who range include the Pacific Basin may be observed, however rare. The Pacific Golden Plover, Pluvialis dominica fulva, has been observed miles from the Proposed Subject Parcel, during the Winter.

No archeological sites or features of any kind were found either within or immediately adjacent to the boundaries of the Proposed Subject Parcel.

There are no known endemic amphibians or land reptiles in the Hawaiian Chain. Those that may be present in the Proposed Subject Parcel area are introduced species and are insect dependent. The Proposed change in designation to Geothermal Resources Subzone would be an extension of existing boundaries and conditions expanded from the existing Hawaii Geothermal Project, HGP-Abbott.

The Proposed Subject Parcel designation to Geothermal Resource Subzone will not have a significant impact on the surrounding areas. Vacant subdivided agricultural parcels surround the Proposed Subject Parcel, with the exception of three dwellings that are located in the adjacent subdivision that is already designated as a Geothermal Resource Subzone. The Proposed Subject Parcel has been cleared and bull-dozed for use as a papaya farm. The land remains unproductive due to poor soil quality and excessive rainfall.

The area is generally under-developed as a residential community and under-utilized as an agricultural subdivision. There are 2,000 one-acre lots in the adjacent Leilani Estates Subdivision and approximately 200 residences clustered on the western end of the subdivision. The subdivision was completed approximately 20 years ago and land prices have remained the same. Potentials are limited and further development in the subdivision appear slowly. The direction of wind patterns does transport hydrogen sulfide emissions from the HGP-A Well over the eastern portions of Leilani Estates Subdivision, however, there are no residences located in that eastern area.

There will be no displacement of agricultural lands or activities as a result of the designation to Geothermal Resource Subzone. Area residents could benefit from employment opportunities or at least work close to their residence. Retail and service facilities will locate and grow in the immediate area and the County of Hawaii and State of Hawaii

would benefit from the increased tax base. Finally, it is the local residents who will benefit most from the available low cost energy resource. Model projects and energy grants utilizing geothermal energy to replace fossil fuel electricity may be a priority in the next decade.

(5) The Compatibility of Development and Utilization of Geothermal Resources within the Proposed Area With Other Allowed Uses Within the Area and Within The Surrounding Lands.

One-acre agricultural subdivision parcels adjacent to the Proposed Subject Parcel would add to the development and utilization of Geothermal Resources. First, by its use as affordable residential area. Workers could reside close to where jobs and industries are located. Second, one-acre agricultural parcels could be used as a location to grow maturing aquaculture and marine-culture species. Following breeding and propagation in temperature-controlled ponds located in a Geothermal Resource Subzone, the young species are brought to affordable one-acre agricultural parcels for growth to maturity. After maturity, the aquaculture and marine-culture species are harvested and brought to a Geothermal Resource Subzone Site where the adult species can be processed, refrigerated and prepared for marketing and shipment. Aquaculture and marine-culture products would include catfish, talapia, abalone, prawns, micro-algae, sturgeon eggs and other agricultural products that would use the residual steam for processing and treatment.

The treatment of papaya for overseas shipment could be accomplished using residual steam. Residual steam from the electric generating plant could be used to sterilize the medium on which mushrooms would grow. Large batches of soil and medium could be sterilized in vats to grow ginger roots and other specialized crops. The many one-acre parcels located near-by would become productive farms growing a high-priced agricultural product.

One-acre agricultural parcels that are located in the Geothermal Resource Subzone have the added advantage in which geothermal steam could be used on the property. Greenhouses, with controlled temperatures, could be built to grow specialized crops. Strawberries and asparagus grown in optimum temperatures are cultivated in Keahole NELH farms using OTEC technology. These surrounding parcels would be available to support the geothermal development.

Within the area to the East, across Pohoiki Road, is situated the HGP-A Well Demonstration Project. The project incorporates a electrical generating plant, a research and development facility and several demonstration projects sponsored by the State and Federal governments.

The success of the HGP-A Well Project reinforces the development and utilization of geothermal resources in the area. Availability of high-temperature geothermal resources, both quality and quantity, was proved by use of geochemical, geophysical and deep-drilling methods. The chemical

composition of geothermal fluids can be determined only by deep-drilling of exploratory well tests. The Steam content, temperature and volume is the real measure of a quality geothermal producing well.

The Potential Benefits To Be Derived From Geothermal Development and Utilization In The Proposed Area Are In The Interest of the County of Hawaii and the State of Hawaii.

The State of Hawaii is dependent on imported petroleum for more than 90% of its energy supplies. Shortage of oil supply or escalation in the price of oil would adversely affect economic and social conditions in the entire State.

It is of State priority to reduce its dependence on imported petroleum by the development of renewable energy sources. Geothermal energy is considered the State's best near-term prospect for renewable energy resource, producing enough electricity from an indigenous source.

Geothermal resource development must be developed where the resource occurs. The proposed subject parcel for designation is located in a sector that shows promise of high-temperature geothermal resource, however, the chemical composition can be established only by an exploratory deep-well test drill. A designation of Geothermal Resource Subzone designation would permit a geothermal developer to apply for exploratory drilling permits to locate the quality

and quantity of geothermal fluids within the Geothermal Resources Subzone for the production of geothermal fluids required for the generation of electricity.

The discovery and use of indigenous renewable energy resources would reach the State's goal of achieving energy self-sufficiency in an area which are compatible with the social, economic and environmental concerns of the County and State of Hawaii.

Potential benefits to be derived from the utilization of residual steam which could be derived from as much as 90% of the total steam energy produced. Applications of residual steam would be in the field of heating, cooling and sterilization upon direct application.

Industries that could benefit from these applications include agricultural products, aquaculture, food processing, refrigeration, dehydration, greenhouse operations, health spas, textile dyeing and ice making.

Geothermal steam benefits could impact on neighboring one-acre subdivision parcels that could be used as both residential and support facilities. Heated water for household use could be a direct application of geothermal fluids. Other uses include air-conditioning and a source of both potable water and electricity.

The maturing of aquacultural species and of agricultural products all need support facilities. Property values would eventually rise which would increase the tax base of the State.

The construction of desalination plants using steam energy could be developed to supplement the local water supply. Although rainfall exceeds 100 inches per year, in the Puna District, water must be conserved as a State policy. The manufacture of ice using heat transfer methods and the establishment of cold storage facilities would assist local fishermen. These and many more innovative applications of heat and steam resources would benefit the economy and increase the tax base of the County of Hawaii and the State of Hawaii as a whole.

CONCLUSION: The Geothermal Resource Subzone Designation would permit additional exploration and use of geothermal resources in a promising geothermal energy sector located adjacent to a known geothermal energy producing well site. Geothermal Resource Subzone Designation would permit the use of geothermal fluids and residual steam from operational electric generating plants located in close proximity.

Additional social, economical and environmental impacts would be minimized in an area already exposed to the effects of geothermal exploration and development. There would be no significant displacement of agricultural lands or loss of potential agricultural production.

The Geothermal Resource Subzone Designation would permit industrial use of available residual steam from the electric generating plants in operation which would otherwise be wasted.

A. S. FURUMOTO
Geophysical Consultant
349 Kekupua St.
Honolulu, Hawaii, 96825

June 14, 1988

Integrated Resources, Inc.
535 Ward Ave, Suite 211
Honolulu, HI, 96814

and

Board of Land and Natural Resources
Department of Land and Natural Resources
State of Hawaii

Gentlemen:

This letter addresses the geothermal potential of the property in Puna, on the island of Hawaii, owned by Integrated Resources, Inc.

That there is a geothermal resource of commercial value in Puna has been definitely proven by the HGP-A well. The question about the property owned by Integrated Resources, Inc., can be answered by outlining the size of the geothermal aquifer discovered by HGP-A, and by seeing whether the property overlies the aquifer.

In the 1970's I directed geophysical and geological surveys carried out by the University of Hawaii in search for geothermal resources. I still have the data from the surveys in my files.

There are several ways to outline a known geothermal aquifer, namely electrical resistivity surveys, microearthquake surveys and drilling holes in a grid pattern. The aquifer discovered by HGP-A has a problem in that it is deep, 5000 feet below the surface. Because of the great depth more exploratory drilling is economically out of the question since a single hole will cost over a million dollars. Depth also presents a problem for electrical resistivity survey, as resolution will be lost. Resistivity surveys will confirm that there is hot water down there but will not add further information than that. The only alternative left is carrying out microearthquake surveys.

A microearthquake survey was carried out after the HGP-A well was drilled. Figure 1 is a map showing the epicenters of microearthquakes detected by the survey and Figure 2 shows the vertical distribution of the earthquakes. In Figure 2 we notice that there is a cluster of earthquakes surrounding the well. The cluster has been shaded in gray in the figure for illustrative purposes. The cluster can be interpreted as outlining the geothermal aquifer. Earthquakes are associated with a geothermal aquifer because groundwater coming into contact with hot rocks causes the rocks to crack. The other earthquakes not associated with the aquifer, those earthquakes not included in the shaded section, are tectonic in nature -- the ocean side of the mountain mass is continually sliding into the ocean and earthquakes accompany the sliding. For our purpose we shall ignore tectonic earthquakes.

The cluster when projected onto the map of Figure 1 became the ellipse shown by a broken line. The ellipse was then projected onto a commercially available topographic map for better identification (Figure 3). Figure 4 is a property map provided by Integrated Resources, Inc. Notice that a good part of the property sits on top of the geothermal aquifer.

Even if the property were off the aquifer, a drill hole located within the property can slant drill and tap the aquifer.

The conclusion is that the property owned by Integrated Resources, Inc., has geothermal potential.

Sincerely yours,

Augustine S. Furumoto

Augustine S. Furumoto
Geophysical Consultant

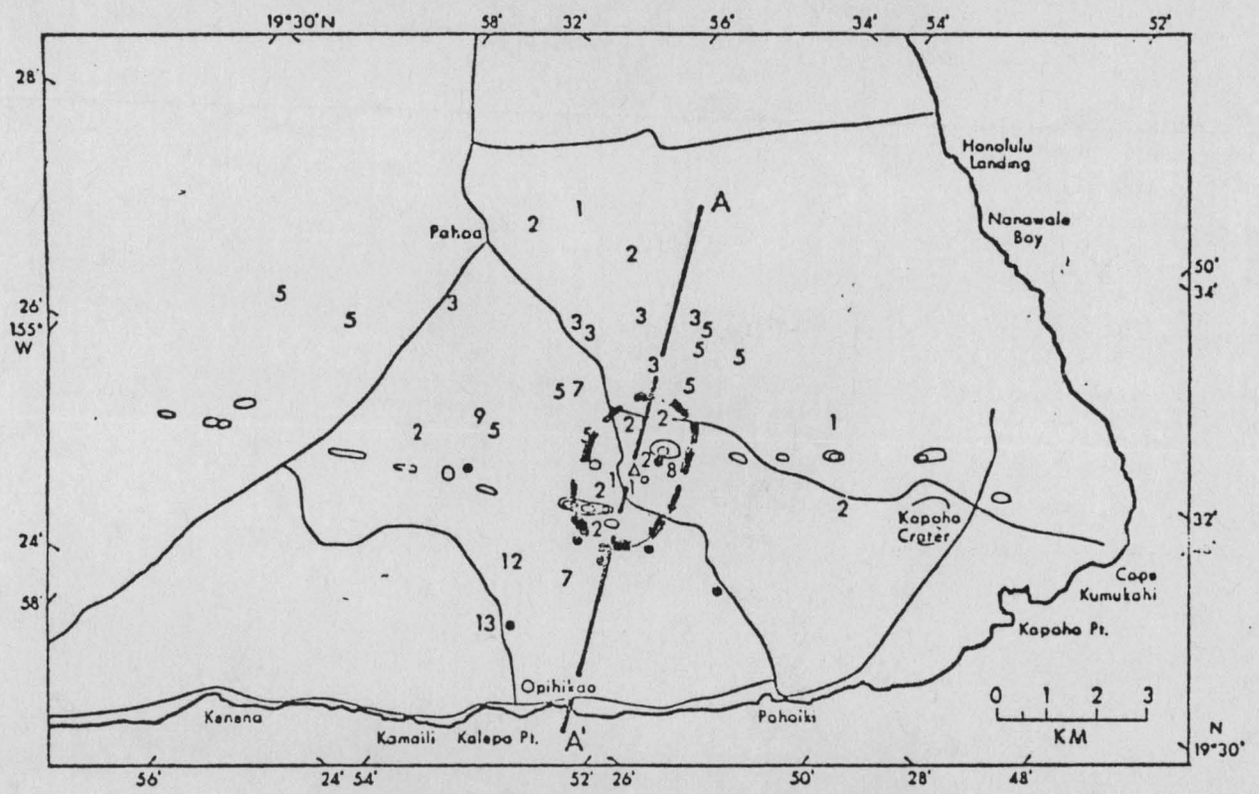


Figure 1 Epicenters of earthquakes near the Malama-Ki array with crustal model of Broyles et al. (1978).

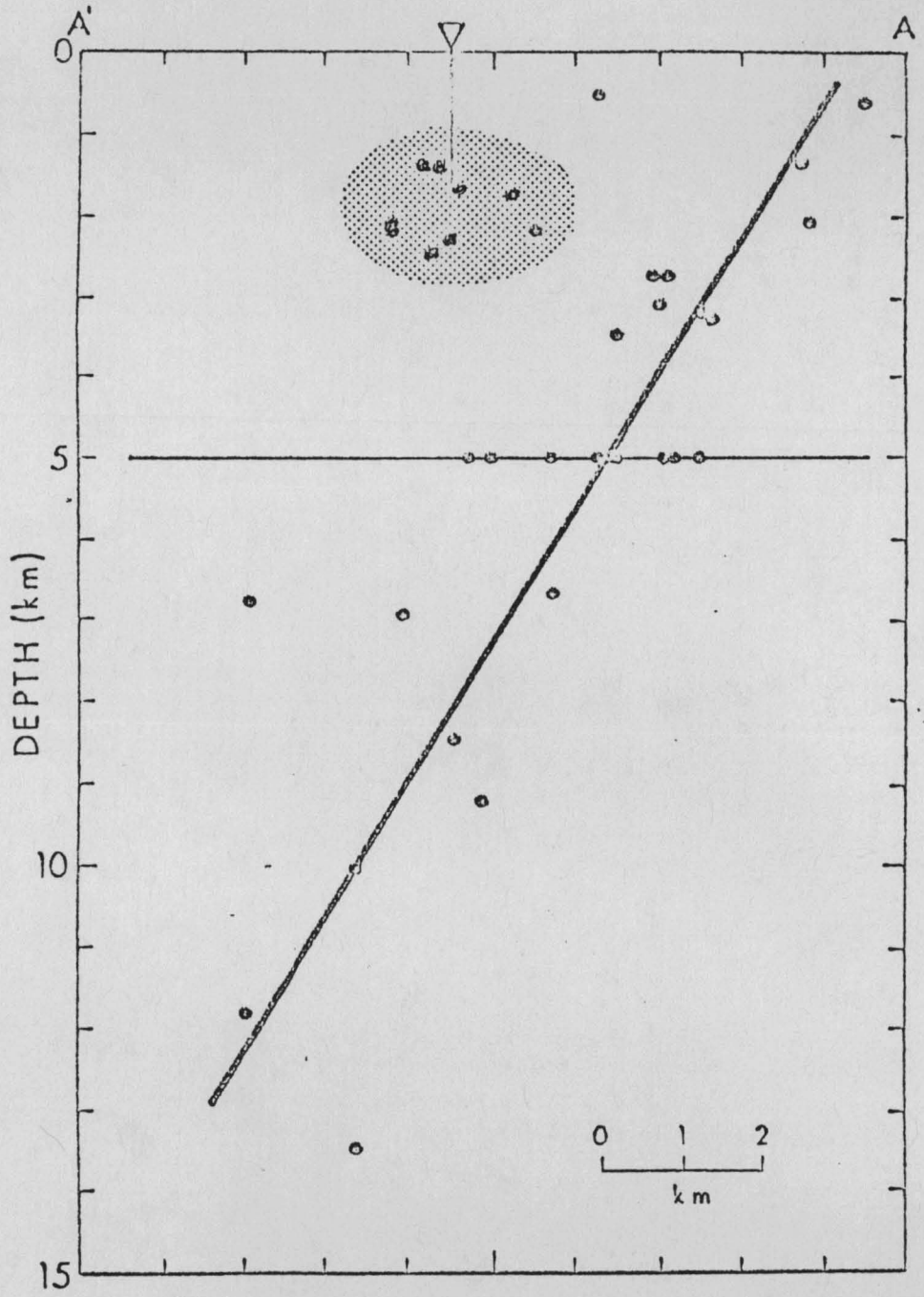


Figure 2. Earthquake foci plotted onto vertical plane through line AA' of Figure 1. Triangle represents HGP-A well. Lines show planes along which the mountain mass is sliding.

Figure 3. Extent of Geothermal Aquifer.

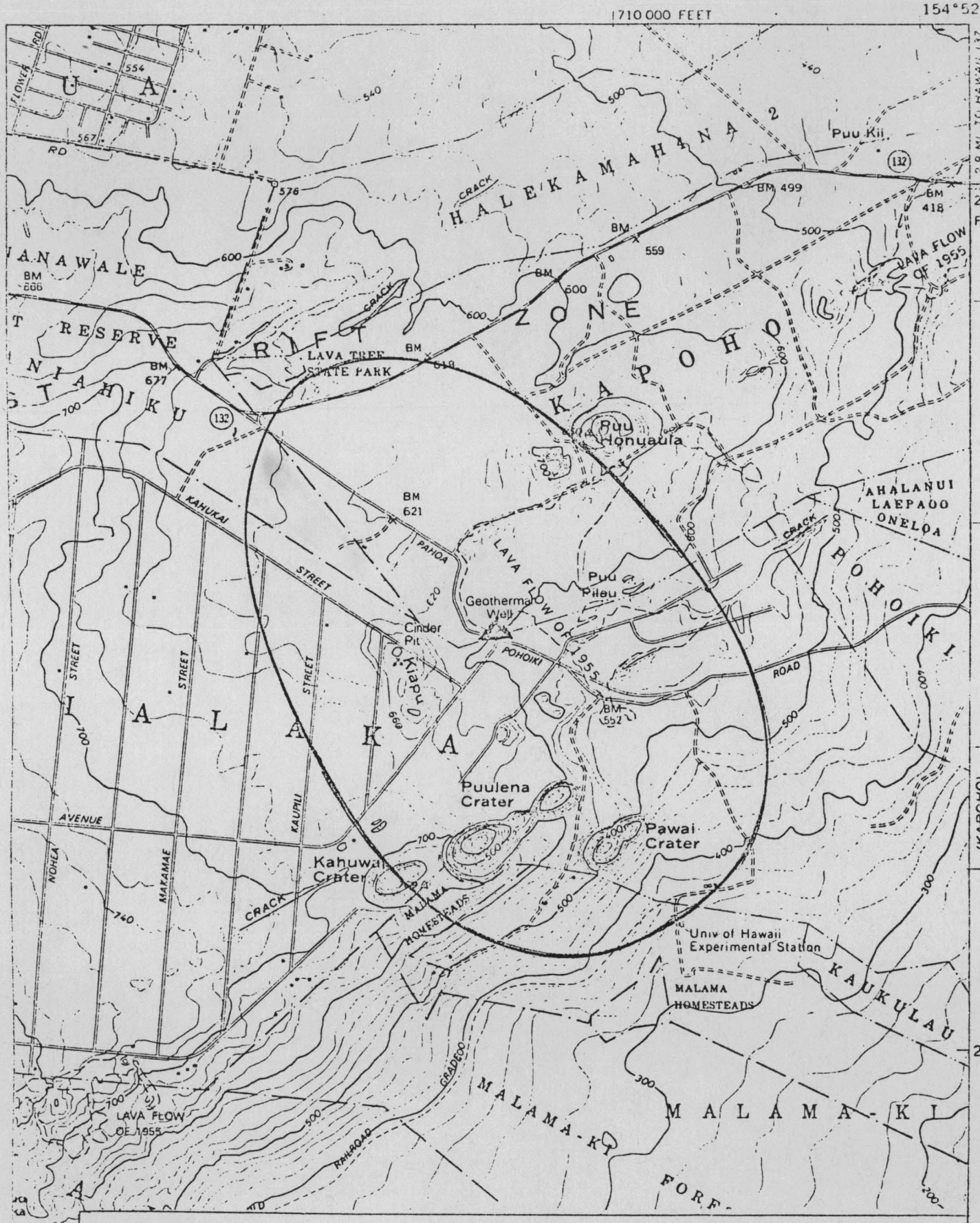
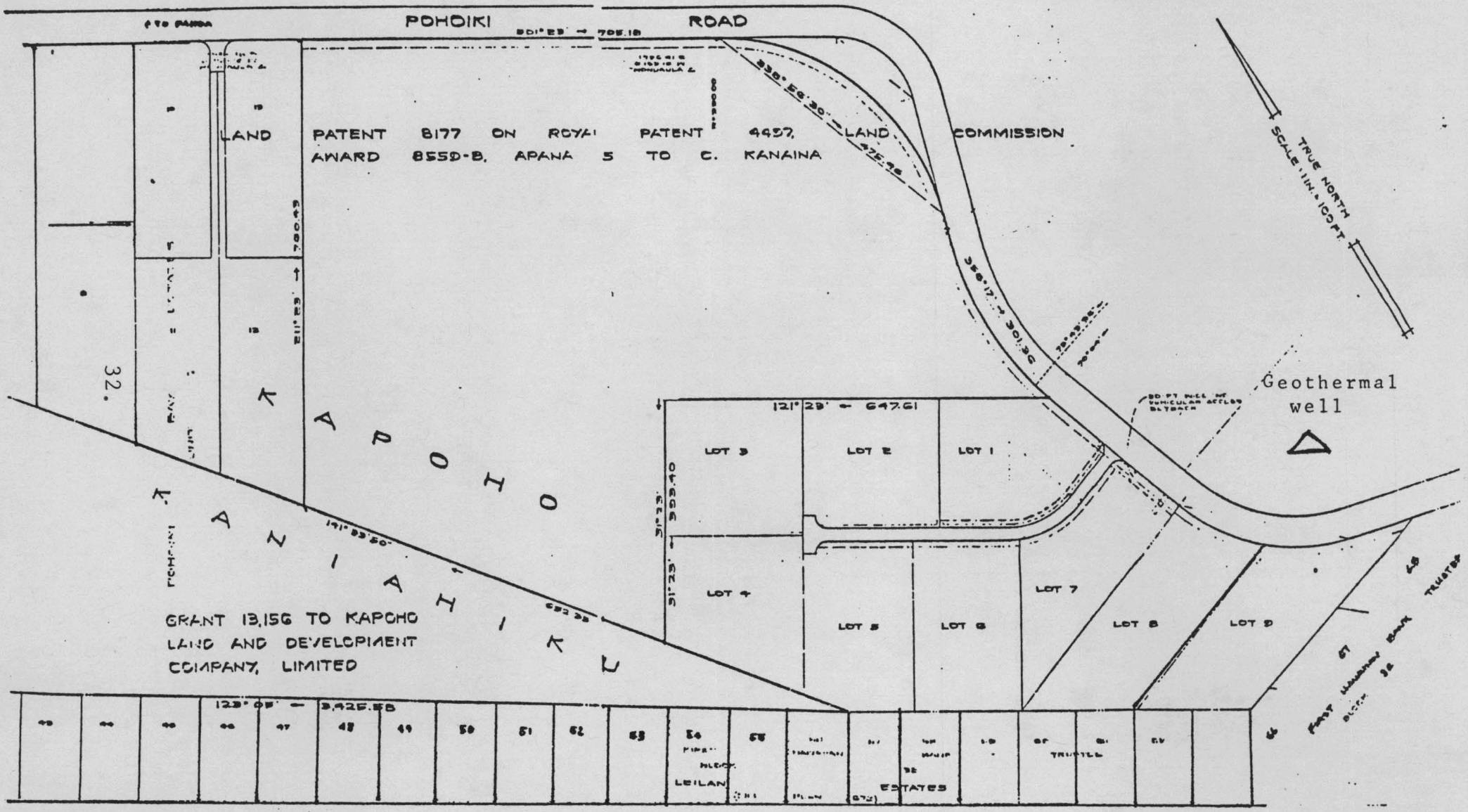


Figure 4. Property map near geothermal well HGP-A. All of the lots sit on the aquifer.



JUNE 16, 1988

BOARD OF LAND AND NATURAL RESOURCES
STATE OF HAWAII
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DEAR SIRS:

WE ARE PROPERTY OWNERS IN POHOIKI BAY ESTATES SUBDIVISION, TAX MAP KEY: 1-04-90-05, LOCATED IN THE PUNA DISTRICT OF THE ISLAND OF HAWAII. OUR PARCEL IS ADJACENT TO AND ABUTTING THE 40 ACRE PARCEL OWNED BY INTEGRATED RESOURCES, INC.

THE PARCEL WE OWN IS WITHIN THE GEOTHERMAL RESOURCE SUBZONE WHICH WOULD PERMIT THE USE OF GEOTHERMAL FLUIDS AND STEAM. THE HGP-A DEMONSTRATION WELL IS LOCATED ACROSS THE STREET, HOWEVER, EXCESS STEAM FROM THE HGP-A ELECTRIC GENERATOR CANNOT BE MADE AVAILABLE TO OUR PROPERTY DUE TO ROADWAY RESTRICTING SET BY COUNTY AND STATE REGULATIONS.

WE WISH TO MAINTAIN THE PRESENT GEOTHERMAL RESOURCE SUBZONE DESIGNATION ON OUR PROPERTY AND UTILIZE GEOTHERMAL FLUIDS AND STEAM ENERGY SHOULD THEY BECOME AVAILABLE IN THE FUTURE.

WE ARE IN FULL SUPPORT OF THE REQUEST MADE BY INTEGRATED RESOURCES, INC. FOR GEOTHERMAL RESOURCE SUBZONE DESIGNATION TO ITS 40 ACRE PARCEL. IT WOULD THEN BE POSSIBLE TO EXPLORE FOR GEOTHERMAL ENERGY OR USE STEAM ENERGY ON THE PREMISES.

POTENTIAL BENEFITS WOULD BE IN UTILIZATION OF AVAILABLE STEAM ENERGY FROM PRODUCING GEOTHERMAL WELLS. THE ENTIRE AREA COULD BENEFIT FROM GEOTHERMAL ENERGY. NEW BUSINESSES RELATED TO STEAM USES COULD BE LOCATED HERE.

WE HAVE WATER AND ELECTRICITY AVAILABLE IN OUR PROPERTY, HOWEVER, WITH THE AVAILABILITY ON GEOTHERMAL ENERGY, IT IS HOPED THAT THIS ENERGY COULD BE UTILIZED TO TREAT AND PURIFY CATCHMENT WATER, WHICH WOULD BENEFIT NEIGHBORING COMMUNITIES THAT DEPEND ON WATER CATCHMENT SYSTEM AS THEIR ONLY SOURCE OF WATER.

SINCERELY,

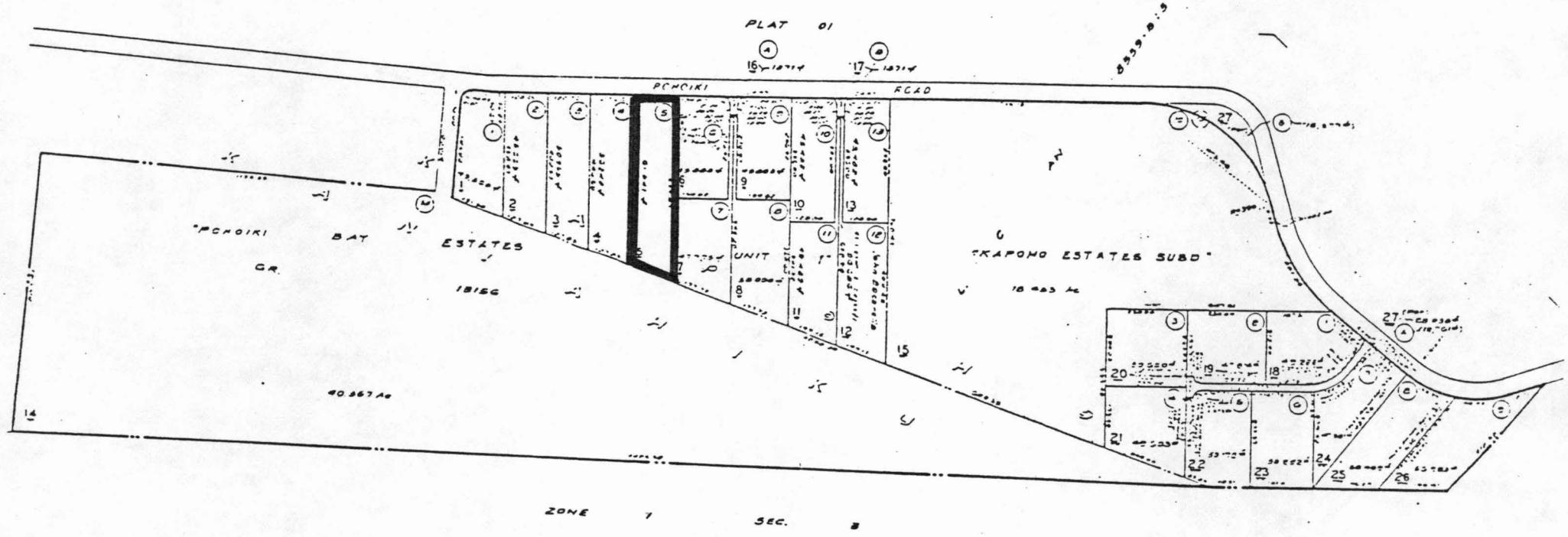
Norman Kawabata

NORMAN KAWABATA (OWNER)

June Kawabata

JUNE KAWABATA (OWNER)

ATTACHMENT: PROPERTY LOCATION MAP



DEPARTMENT OF TAXATION
PROPERTY TECHNICAL OFFICE
TAX MAPS BRANCH
STATE OF HAWAII

TAX MAP

THIRD TAXATION DISTRICT

ZONE	SEC.	PLAT
1	4	90

SCALE: 1 IN. = 200 FT.

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